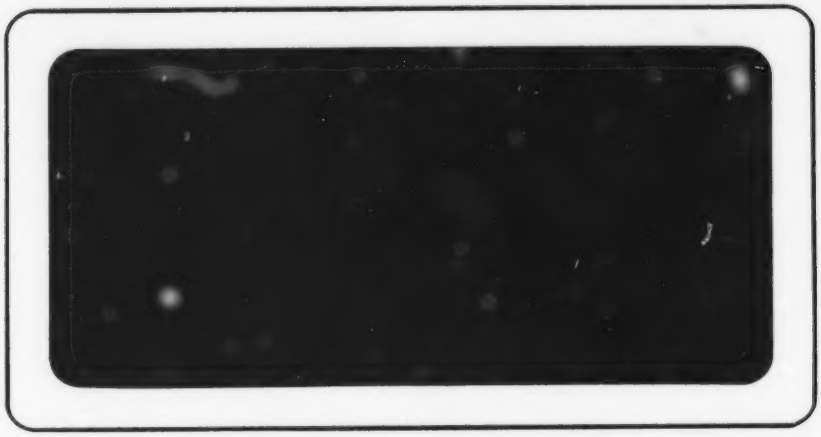

Province of British Columbia

Ministry of Environment

WATER MANAGEMENT BRANCH

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MINISTRY OF ENVIRONMENT
PROVINCE OF BRITISH COLUMBIA

AMBIENT WATER QUALITY CRITERIA FOR MERCURY

Prepared pursuant to Section 2(e) of the
Environment Management Act, 1981

Approved: 4 Oct 89
Date

Associate Deputy Minister

90-01772/

SUMMARY

This report is one in a series which establishes ambient water quality criteria for British Columbia. The criteria are safe conditions or levels of contaminants, applicable province-wide, which are set to protect various water uses. This report sets criteria for mercury to protect drinking water, freshwater and marine aquatic life, wildlife, livestock, irrigation, and recreation. The criteria are summarized in Table 1 at the back of the report.

The criteria for aquatic life are similar to the CCREM Canadian Water Quality Guidelines (1987), except that we have added a 30-day average to protect aquatic life against long-term effects. There are no CCREM guidelines for marine life, wildlife, irrigation, recreation, and industrial water uses for which we have set criteria.

A major use of the criteria is to set ambient water quality objectives. The objectives are the criteria modified or adopted to protect the most sensitive designated water use in a particular body of water. The objectives are used in the preparation of waste management Permits, Orders, or Approvals, which are the only documents to have legal standing. The objectives, however, are not usually part of these documents.

PREFACE

The Ministry of Environment is developing province-wide ambient water quality criteria for variables that are important in the surface waters of British Columbia. This work has the following goals:

(i) to provide criteria for the evaluation of data on water, sediment, and biota for water quality assessments;

(ii) to provide criteria for the establishment of site-specific ambient water quality objectives.

The ambient water quality objectives for specific waterbodies will be based on the criteria as well as on present and future uses, waste discharges, hydrology/limnology/ oceanography, and existing background water quality. The process for establishing water quality objectives is more fully outlined in "Principles for Preparing Water Quality Objectives in British Columbia", copies of which are available from the Water Management Branch.

Neither criteria nor objectives, which are derived from them, have any legal standing. The objectives can be used in calculating the limits to be allowed in waste discharges. These limits are set out in waste management permits which do have legal standing. The objectives are not usually incorporated as conditions of the permit.

The definition adopted for criterion is: "A maximum and/or a minimum value for a physical, chemical or biological characteristic of water, sediment or biota, applicable province-wide, which should not be exceeded to prevent specified detrimental effects from occurring to a water use, including

aquatic life, under specified environmental conditions."

The criteria are province-wide in application, but use-specific, and are being developed for the following water uses:

-Drinking, public water supply and food processing*
-Aquatic life and wildlife
-Agriculture (livestock watering and irrigation)
-Recreation and aesthetics**
-Industrial (water supplies)

The criteria are set after considering the scientific literature, criteria from other jurisdictions, and general conditions in British Columbia. The scientific literature gives information on the effects of toxicants on various life forms. This information is rarely totally conclusive because it is usually based on laboratory work which only approximates actual field conditions. To compensate for this uncertainty, criteria have built-in safety factors. We use safety factors which are conservative but reflect natural background conditions in the province.

Given this procedure for setting criteria, the objectives will, in most cases, be the same as criteria. However, in some cases, such as when natural background levels exceed the criteria, the objectives could be less stringent than the

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*The criteria apply to the ambient raw water source before it is diverted or treated for domestic use. The Ministry of Health regulates the quality of water for domestic use after it is treated and delivered by a water purveyor.

**Criteria relating to public health at bathing beaches will be the same as those used by the Ministry of Health which regulates their use.

criteria. In relatively rare instances, for example if the resource is unusually valuable or of special provincial significance, we could increase the safety factor by using objectives which are more stringent than the criteria. Another approach in such special cases would be to develop site-specific criteria by carrying out toxicity experiments in the field. This approach is costly and time-consuming and therefore not often used.

The criteria will be subject to review and revision as new knowledge becomes available, or as other circumstances dictate.

RECOMMENDED CRITERIA

These criteria are based on information presented in a technical appendix and are summarized in Table 1.

1. DRINKING WATER SUPPLY

For the protection of human health, the concentration of total mercury in raw drinking water should not exceed 1.0 ug/L at any time.

This is consistent with the CCREM (1987) guideline.

2. AQUATIC LIFE

2.1 FRESHWATER AQUATIC LIFE

(a) The average concentration of total mercury in water over a 30-day period (based on 5 weekly samples) should not exceed 0.02 ug/L. This level will protect freshwater aquatic life from the chronic effects of mercury and prevent undesirable accumulation of mercury from water in fish.

(b) To protect freshwater aquatic life from acute effects of mercury, the maximum concentration of total mercury in water should not exceed 0.1 ug/L. This is the same guideline as given by CCREM (1987).

(c) To protect human health, the maximum concentration of total mercury in the edible portion of fish/shellfish should not exceed 0.5 ug/g wet weight*. This is the same guideline given by Health and Welfare Canada.

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* For people whose diet is based primarily on fish, this criterion may need to be varied, as indicated in Table 2.

The 30-day average criterion is in addition to the maximum criterion which is the only CCREM guideline given.

2.2 MARINE AND ESTUARINE AQUATIC LIFE

(a) To prevent undesirable accumulation of mercury from water in fish, the average concentration of total mercury in water over a 30-day period (based on 5 weekly samples) should not exceed 0.02 ug/L.

(b) To protect marine and estuarine aquatic life from acute effects of mercury, the maximum concentration of total mercury in water should not exceed 2.0 ug/L.

(c) To protect human health, the maximum concentration of total mercury in the edible portion of fish/shellfish should not exceed 0.5 ug/g wet weight*. This is the same guideline given by Health and Welfare Canada.

The CCREM (1987) did not recommend mercury guidelines for marine aquatic life.

3. WILDLIFE

The maximum concentration of total mercury in water for wildlife use should not exceed 3.0 ug/L.

The CCREM (1987) did not recommend mercury guidelines for wildlife.

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* For people whose diet is based primarily on fish, this criterion may need to be varied, as indicated in Table 2.

4. LIVESTOCK WATER SUPPLY

The concentration of total mercury in livestock water supply should not exceed 3.0 ug/L at any time.

This is consistent with the CCREM (1987) guideline.

5. IRRIGATION

The maximum concentration of total mercury in irrigation water should not exceed 2.0 ug/L.

The CCREM (1987) did not recommend mercury guidelines for water used for irrigation.

6. RECREATION AND AESTHETICS

In waters used only for primary-contact recreation such as swimming, the total mercury concentration should not exceed 1.0 ug/L at any time.

The CCREM (1987) did not recommend mercury guidelines for recreational water use.

7. INDUSTRIAL WATER SUPPLY

The concentration of total mercury in water used in the food processing industries should not exceed at any time the drinking water criterion of 1.0 ug/L, since such water could be consumed by humans in significant quantities. No criteria are recommended for other industries at this time due to lack of information.

The CCREM (1987) did not recommend mercury guidelines for industrial water supplies.

APPLICATION OF CRITERIA FOR AQUATIC LIFE

1. FORMS OF MERCURY

Toxicity of mercury has been expressed in terms of both total and soluble forms of mercury. However, total mercury is recommended for setting water quality objectives for a given waterbody. The advantages of expressing toxicity on the basis of total mercury concentration are several fold: (i) all the mercury that may potentially be toxic is included in the measurement; if the total mercury concentration in water is within the criteria limits, then it is safe to conclude that no mercury pollution exists; (ii) for comparison purposes, there is a considerable amount of historical information available for total mercury; (iii) total mercury measurement is routine and relatively inexpensive. Mercury in aquatic organisms (e.g., fish) should also be measured when investigating mercury contamination problems.

The main disadvantage of using total mercury to assess water quality is that a large fraction of mercury may become biologically unavailable by forming complexes with the organic and suspended solids fractions of water. Nevertheless, given favourable environmental conditions, mercury complexed in such a manner will be released into the environment in readily available forms, becoming part of the food chain.

2. ASSESSMENT OF EXISTING WATER QUALITY

The criteria recommended in this document are primarily based on laboratory bioassays, which usually are performed using soluble forms of mercury under controlled conditions. Aquatic organisms in a natural environment, however, obtain their mercury burden from both water and food. Also, mercury associated with

the sediment fraction could become available to the organisms under favourable environmental conditions. Thus a measurement of total mercury in water alone cannot be taken as a true measure of a mercury problem in a given waterbody. Other assessment techniques include measurement of mercury in fish, and long-term bioassays with resident species using local water. The guideline for mercury in fish can be used for the assessment of existing water quality. Long-term bioassays are complex and costly, and should be reserved for waterbodies with high fisheries values which are threatened by a controllable source.

3. SETTING WATER QUALITY OBJECTIVES

Natural (i.e., non-anthropogenic) concentrations in a waterbody may not always meet the criteria. In a case where natural mercury concentrations in water equal or exceed the criteria, the objective should be based on the natural levels and any increase in total mercury to be allowed should be based on site-specific investigations.

When natural concentrations of total mercury in undeveloped waterbodies are less than the criteria levels, then the criteria, or more stringent values if justified, should apply. In some cases, socio-economic factors may justify objectives which are less stringent than the criteria. Site-specific impact studies would be required in such cases.

N.K. Nagpal, Ph.D.
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TABLE 1

SUMMARY OF WATER QUALITY CRITERIA FOR MERCURY

Water use	30-day Average* (ug/L total Hg)	Maximum at any time (ug/L total Hg)
Drinking Water Supply	none proposed	1.0
Freshwater Aquatic Life+	0.02	0.1
Marine and Estuarine Aquatic Life	0.02	2.0
Wildlife	none proposed	3.0
Livestock Water Supply	none proposed	3.0
Irrigation	none proposed	2.0
Primary-Contact Recreation	none proposed	1.0
Industrial Water Supply (Food Processing Industry)	none proposed	1.0

* The average is calculated from at least 5 weekly samples taken in a period of 30 days.
+ If natural levels exceed the criteria for aquatic life, the increase in total Hg above natural levels to be allowed, if any, should be based on site-specific data.

TABLE 2

VARIATIONS IN AQUATIC LIFE CRITERIA FOR FISH/SHELLFISH WHEN THE DIET IS BASED PRIMARILY ON FISH.

Concentration of total Hg in edible portion of fish and shellfish (ug Hg/g wet wt.)	Safe quantity for weekly consumption on regular basis (g wet wt.)
0.5	210
0.4	260
0.3	350
0.2	525
0.1	1 050